United States Patent [19]

Thomas

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[45] **Date of Patent:** **Jun. 26, 1990**

[54] **DRIVE PIPE ADAPTOR**

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[73] Assignee: **Seaboard-Arval Corporation,** Houston, Tex.

[21] Appl. No.: **332,001**

[22] Filed: **Mar. 31, 1989**

[51] **Int. Cl.**[5] **E21B 17/02**; E21B 33/03

[52] **U.S. Cl.** **166/88**; 285/138

[58] **Field of Search** 166/77.5, 85, 88, 180; 285/18, 138, 141, 145, 146

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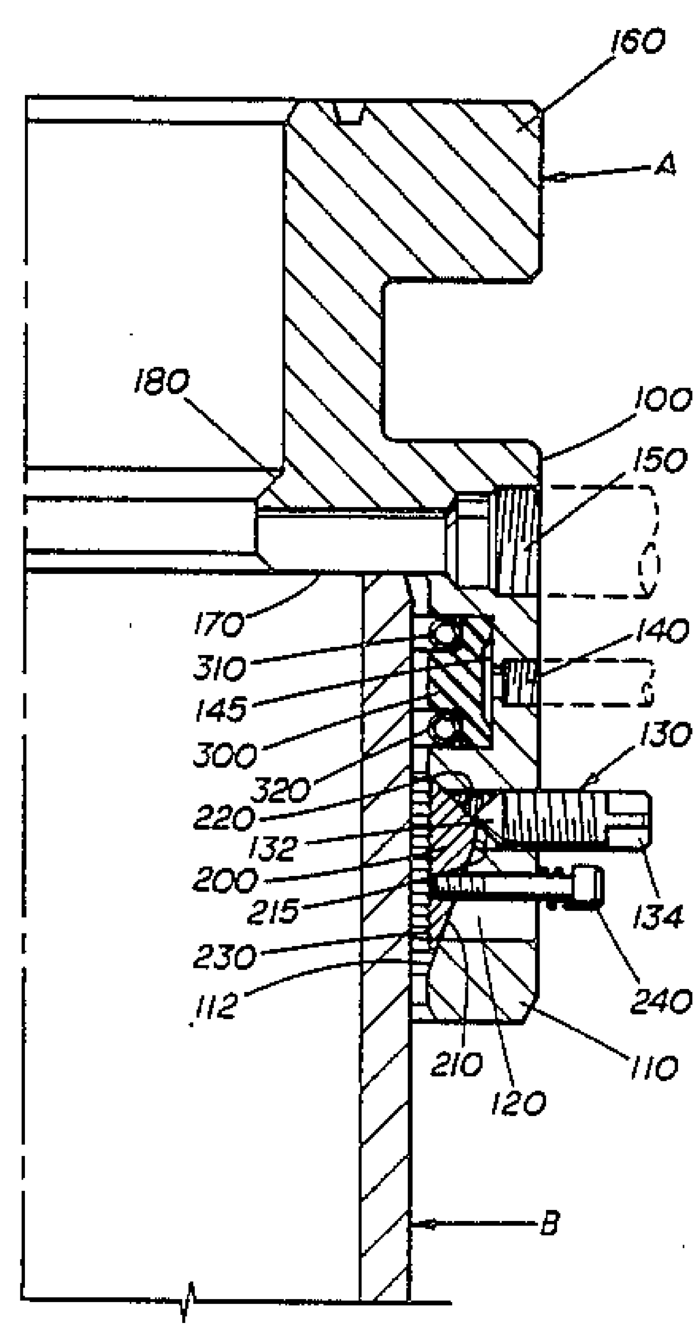
Primary Examiner—William P. Neuder

Attorney, Agent, or Firm—Pravel, Gambrell, Hewitt, Kimball & Krieger

[57] **ABSTRACT**

An adaptor assembly for attaching equipment to a casing head by means of pipe slips or other means of attachment integrated with the assembly, and having an elastomeric seal to contain leakage.

18 Claims, 4 Drawing Sheets



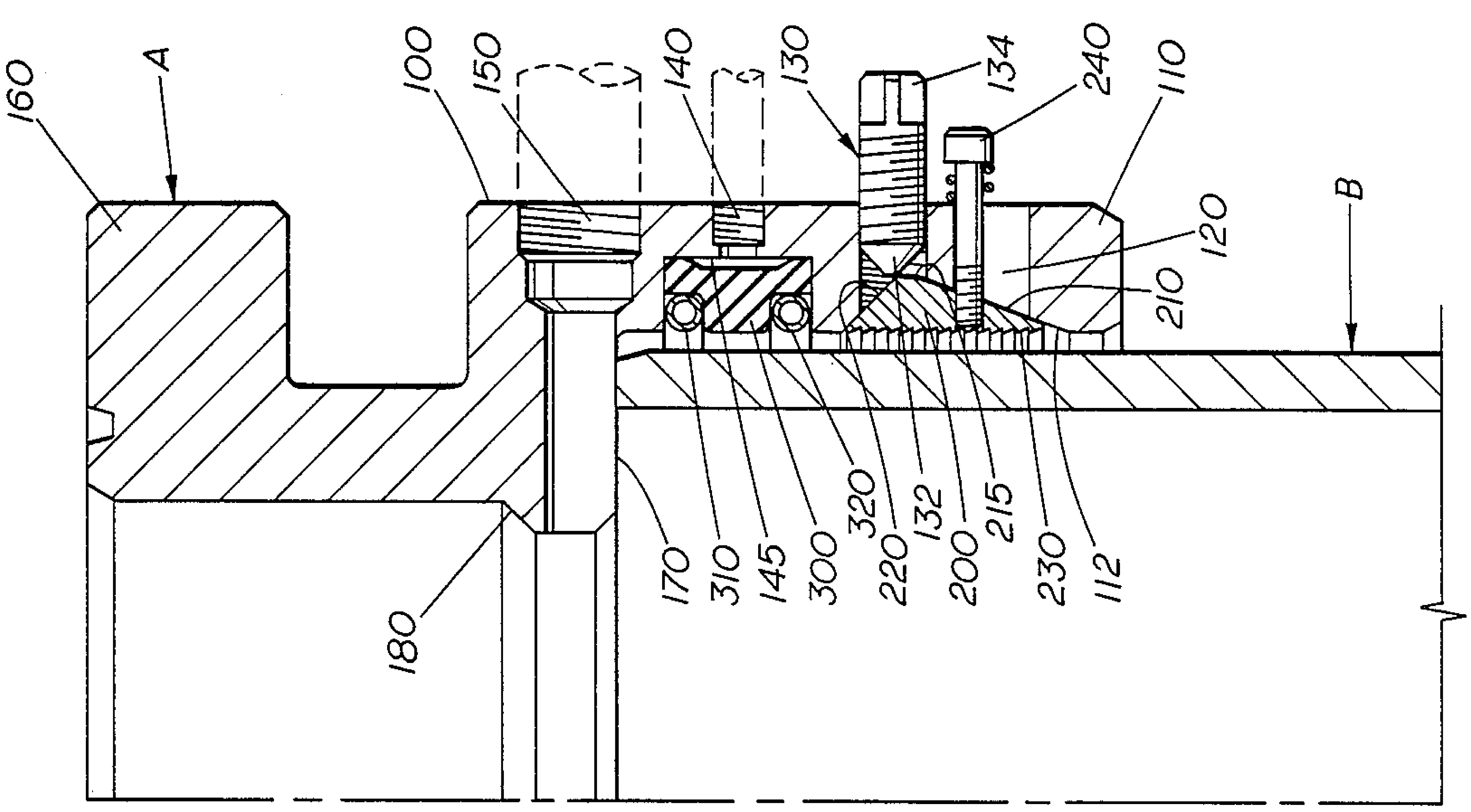


FIG. 1

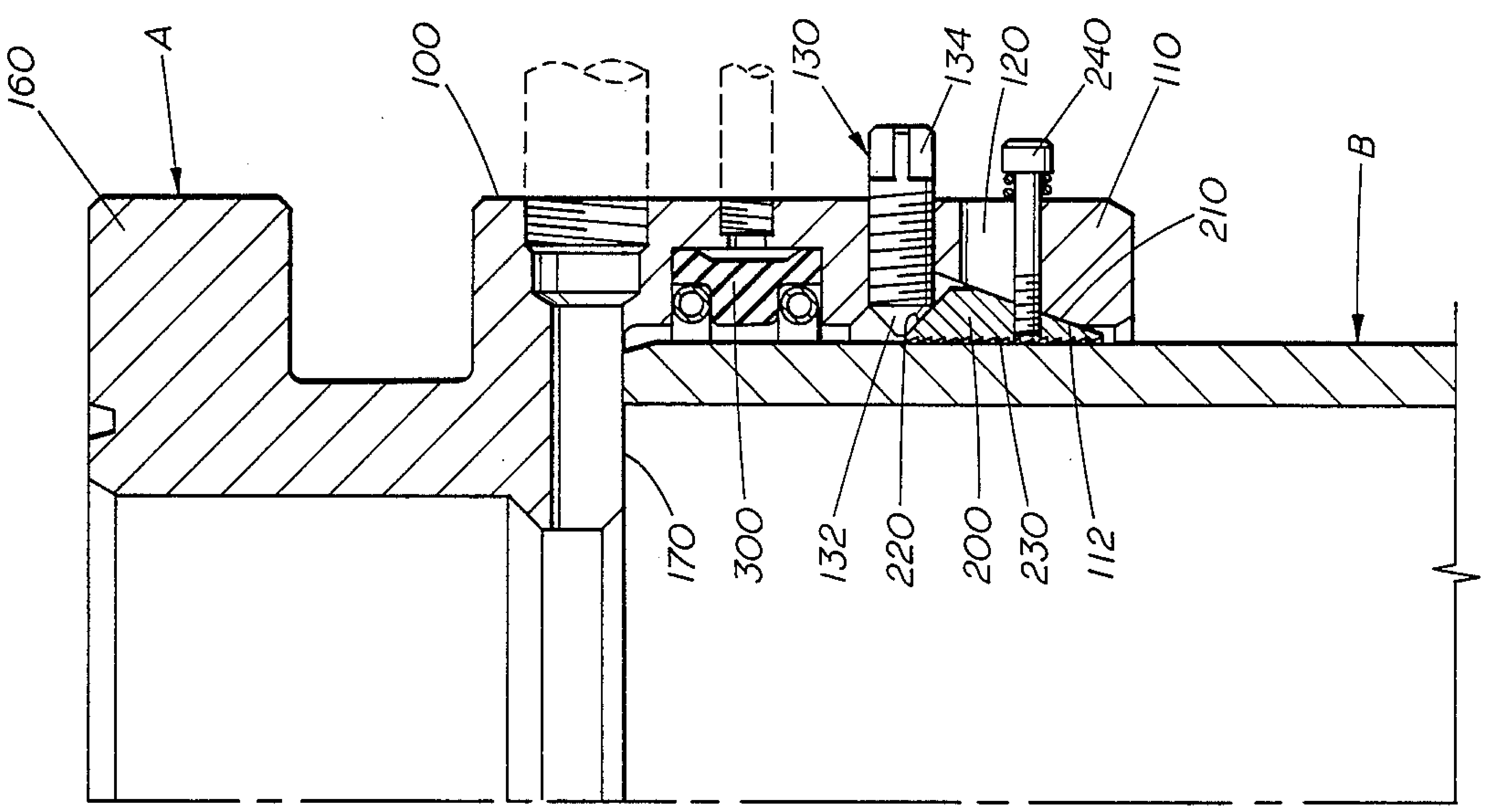


FIG. 2

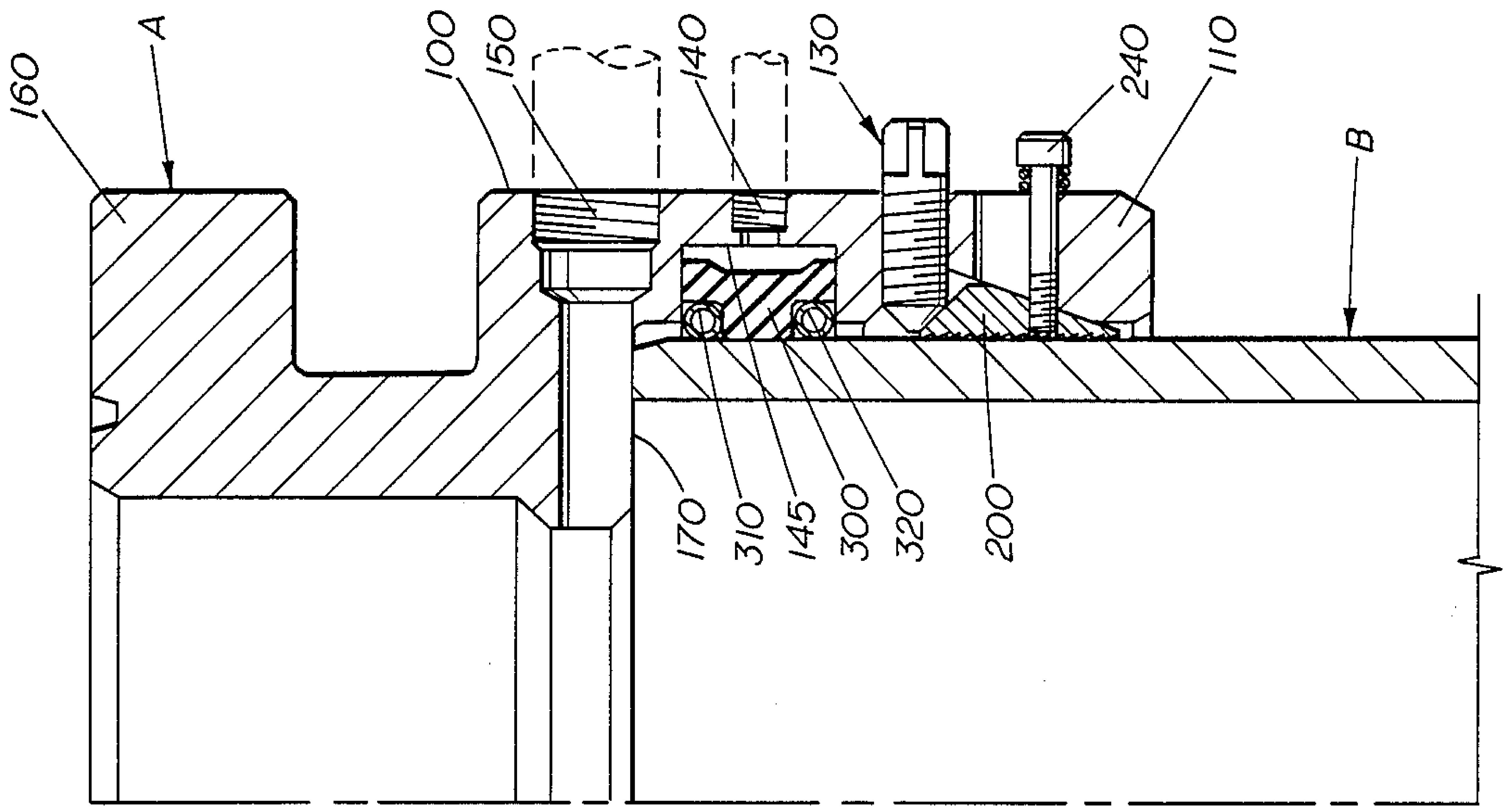


FIG. 3

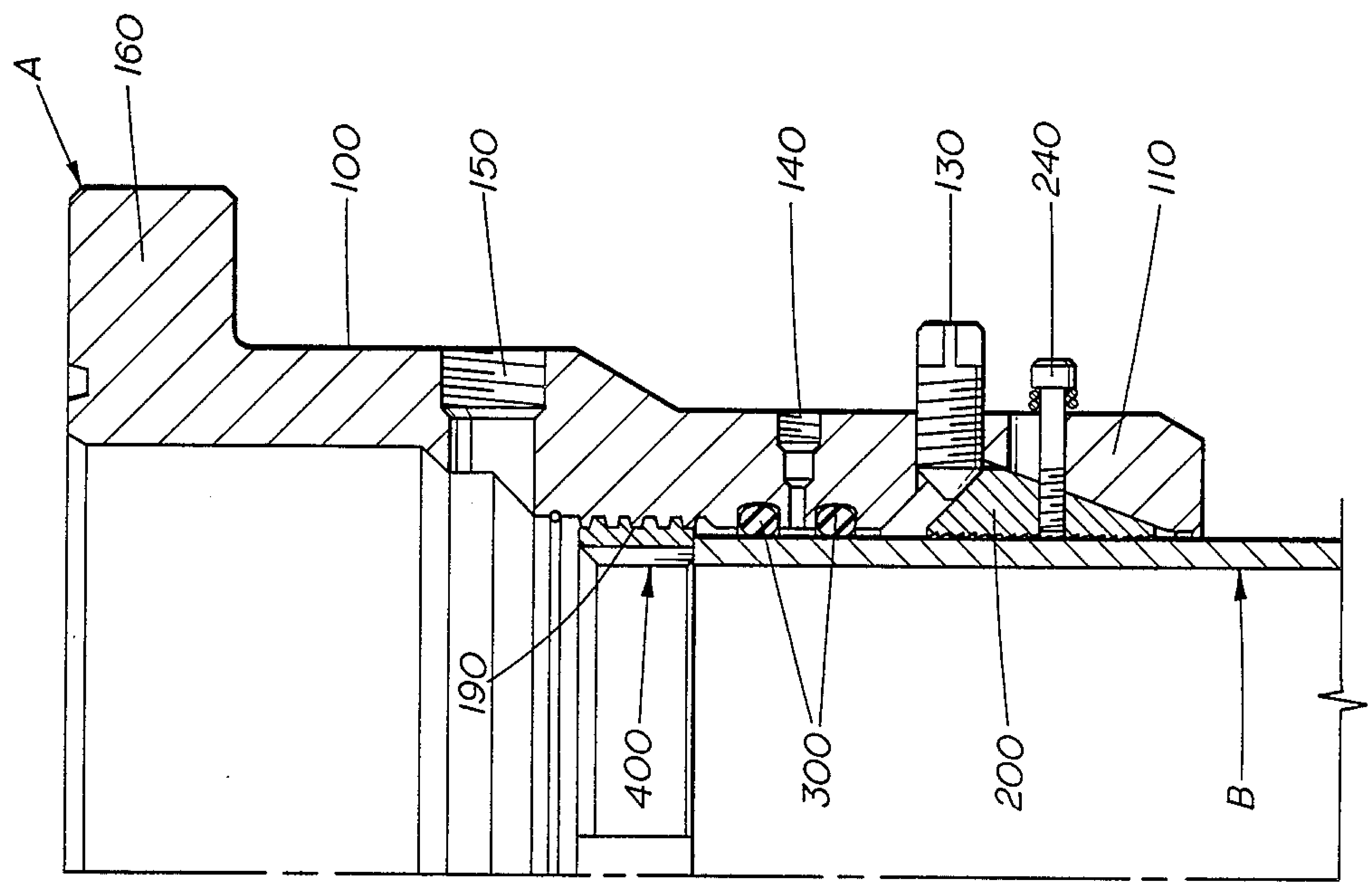

A
160
100
150
140
130
240
110
190
400
300
200
B

FIG.5

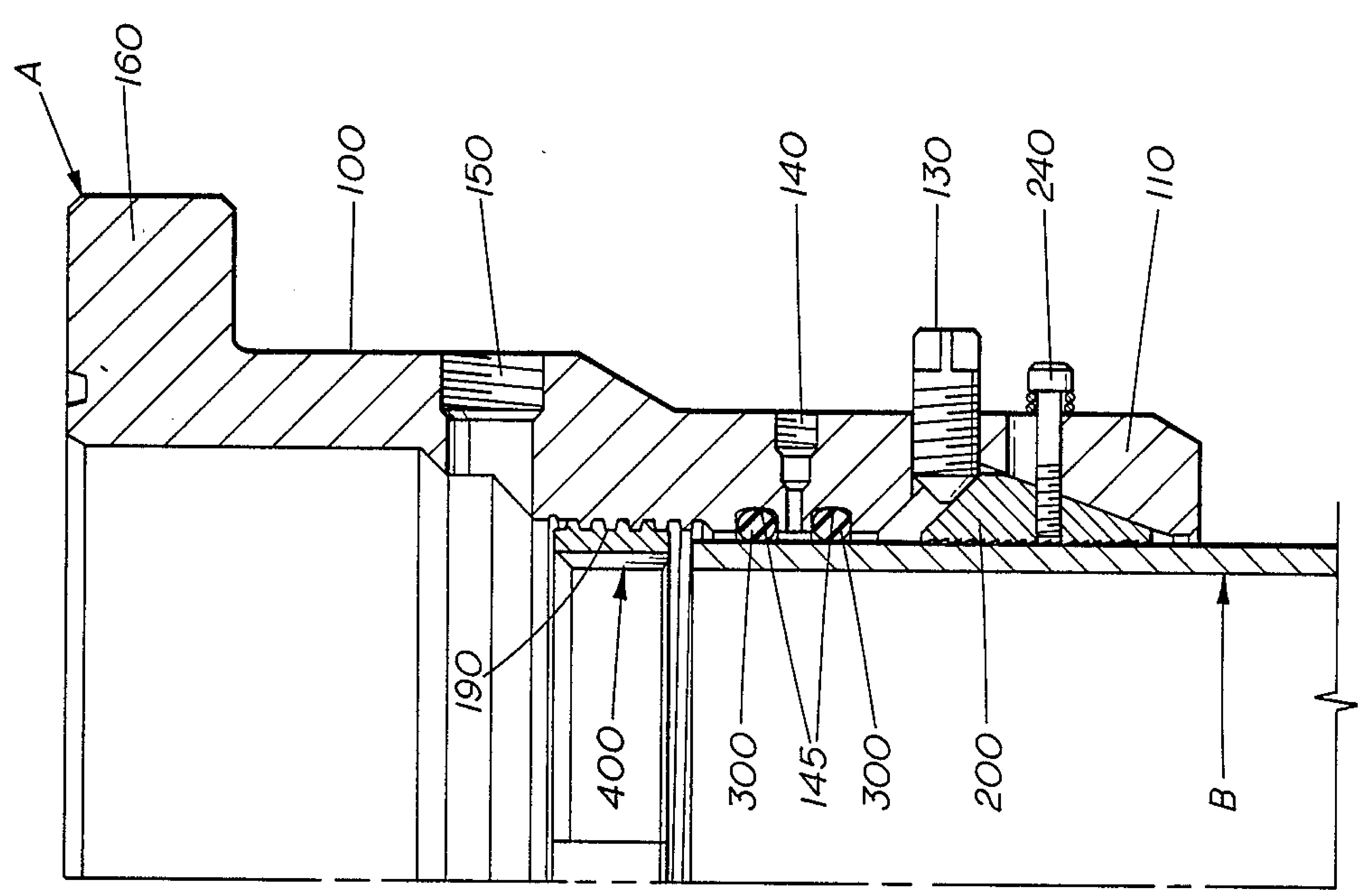

A
160
100
150
140
130
240
110
190
400
300
145
300
200
B

FIG.4

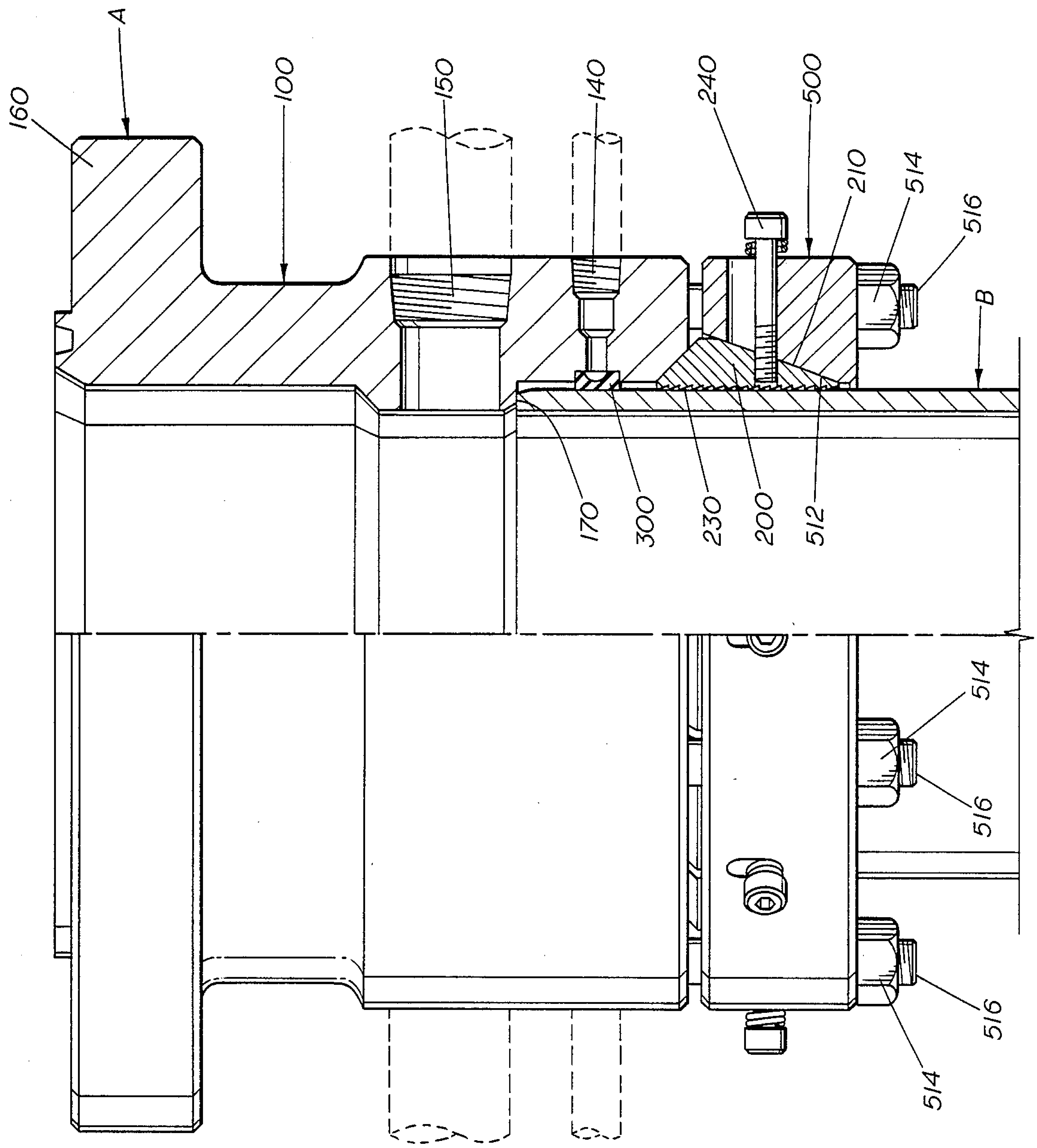


FIG. 6

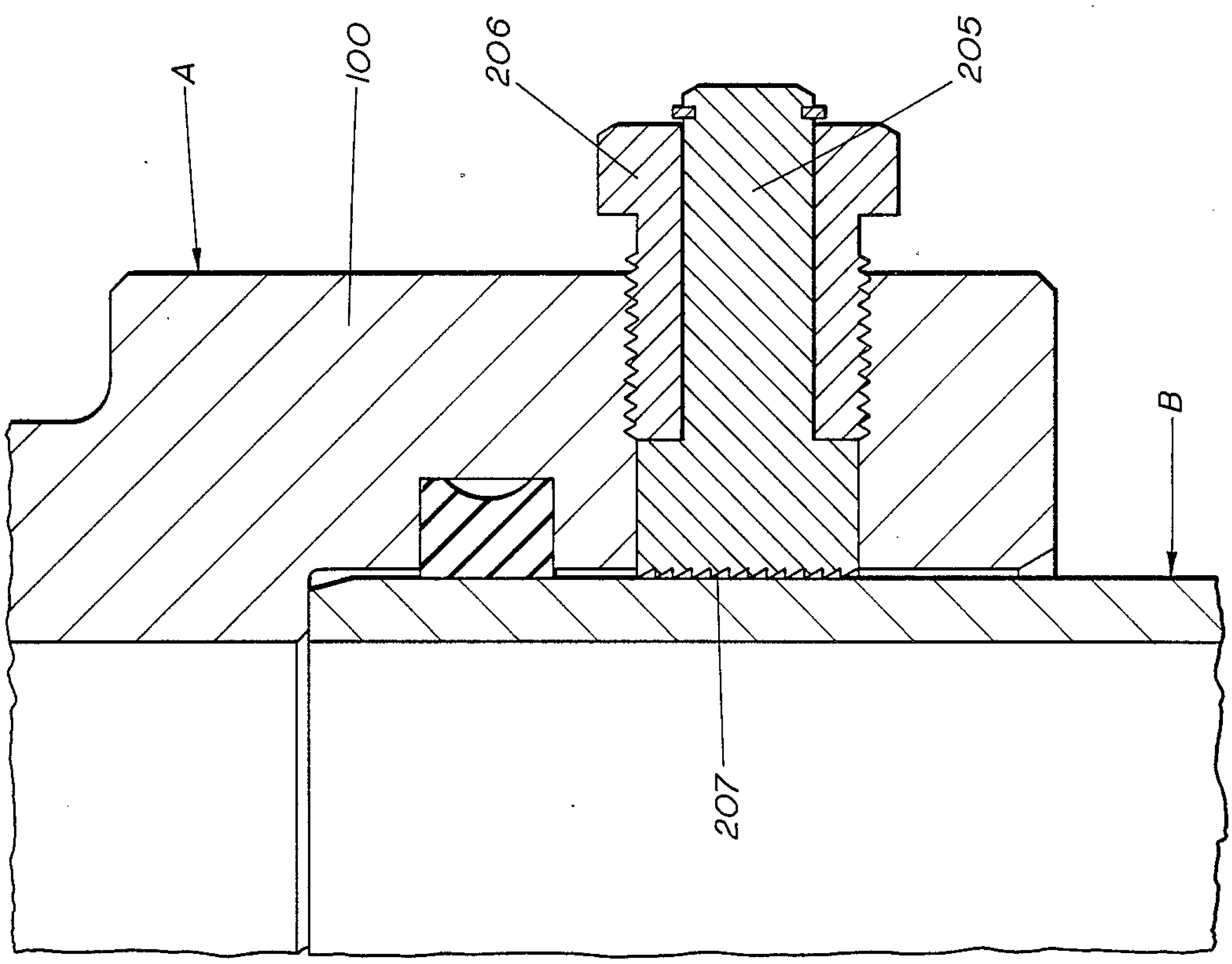


FIG. 7

DRIVE PIPE ADAPTOR

FIELD OF THE INVENTION

This invention is in the field of wellhead equipment, specifically adaptors for attaching to the upper exposed end of a drive pipe to facilitate the attachment of additional equipment to the drive pipe.

BACKGROUND

It is common practice in drilling an oil well to first install a steel pipe or casing in the borehole. This casing serves to seal off fluids from the borehole and to prevent sloughing off or caving in of the walls of the hole. The outermost casing, sometimes called a conductor pipe, is first installed and it is driven or cemented into place in the hole. It serves as a foundation or an anchor for all the subsequent drilling operations. The casinghead is the top end of the casing which protrudes above the surface. It is to the casinghead that control valves and flow pipes are attached. The conductor pipe can also be used to conduct drilling mud through loose layers of earth, such as sand.

In some applications, the conductor pipe also serves to prevent contamination of any fresh water strata which have been penetrated. When driven, conductor pipe is self-supporting, but it does not generally support its weight from the top, when it is cemented in.

When driven, the conductor pipe is installed by being driven into the ground by a pile driver. The impact of the pile driver can upset the upper end of the casing, and it usually does, causing it to be uneven and of varying thickness. A casing which is driven into the ground in this manner must be sufficiently stiff to resist the repeated compressive stress shocking caused by the pile driver. In order to provide the necessary stiffness and to resist the unevenness at the exposed end, a thicker pipe, called drive pipe, is used.

Drive pipe can have an outside diameter ranging up to 48 inches, with 26 to 30 inches being most common. Wall thickness varies from ½ to 2 inches, and roundness can vary from minus ½ to plus one percent of diameter. Usually, a flow control device, fittings and flow pipes are mounted on top of the drive pipe, in conjunction with a diverter system. This diverter system consists of various fittings and air actuated valves used to vent a low pressure gas kick in shallow wells.

Regardless of the type of equipment mounted atop a drive pipe, it is mounted to a flange on a casing head adaptor fitting that is currently welded to the drive pipe. Welding is used because the exposed end of the drive pipe casinghead is rough and uneven after being driven into the ground. Considerable machining would be required to clean up the casinghead and thread it, if a threaded fitting were used. Welding is much quicker and cheaper, so it is the method always used, at least on drive pipe casingheads.

When the casinghead adaptor is welded on the drive pipe, some disadvantages result. A joint must be preheated prior to welding and stress relieved upon completion of the weldment. Both of these operations are time consuming, using two to four hours of expensive rig time. They are also difficult to monitor and control, especially with respect to the rate of temperature rise and fall. Then, the adaptor must either be left in place and abandoned if the well is a dry hole, or it must be cut off the drive pipe and refurbished before being used again. This is time consuming and expensive. This casinghead adaptor is a heavy flanged fitting which not only supports equipment installed above it but also can support production casing suspended inside.

It would be advantageous to have an adaptor which could be mounted on a drive pipe for attachment of a diverter without the need for welding. The aforementioned technical problems associated with welding would be eliminated, and the cost of installation would be materially reduced. This would be particularly useful if the adaptor could be easily removed from a drive pipe and moved to a different well without being refurbished to any great extent. The capability of remaining on the well as the permanent casinghead is also desirable.

SUMMARY OF THE INVENTION

This invention is an adaptor, primarily for use with a diverter system, which can be mounted on the exposed end of a drive pipe, without welding. The adaptor attaches to the bald end of a drive pipe using attachment means such as a set of pipe slip segments which are driven against the surface of the drive pipe by set screws which are threaded through the wall of the adaptor. Instead of set screws, a stud driven wedge ring can be used. Instead of pipe slips, other devices can be used, such as screw actuated lock pins or eccentric dogs. The cylindrical shaped adaptor is lowered over the drive pipe until it bottoms out. The pipe slip segments or other attachment means are located circumferentially around the pipe, within the adaptor cylindrical member. These slips are driven into the pipe surface by tightening the set screws. An elastomeric seal inside the adaptor is pressed against the pipe surface by application of a pressurized fluid behind the seal or by other means, such as in the use of weight actuated seals.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of the adaptor of the present invention showing the drive pipe fully inserted;

FIG. 2 is a sectional view of the adaptor of FIG. 1, showing the pipe slip segments fully engaged;

FIG. 3 is a sectional view of the adaptor of FIG. 2 showing the seal ring engaged;

FIG. 4 is a sectional view of a second embodiment of the present invention, using a stop collar after pressure testing;

FIG. 5 is a sectional view of the adaptor of FIG. 4, showing the stop collar threaded against the drive pipe.

FIG. 6 is a sectional view of a third embodiment of the present invention, using a stud driven wedge ring.

FIG. 7 is a sectional view of a fourth embodiment of the present invention, using screw actuated lock pins.

DETAILED DESCRIPTION OF THE INVENTION

As seen in FIG. 1, diverter adaptor A has adaptor cylindrical member **100** which is a hollow cylinder extending from a selected adaptor flange **160** on its upper end to an annular tapered skirt **110** on its lower end. Adaptor flange **160** is shaped and sized to mate with the diverter or other equipment (not shown) which will be mounted atop the adaptor A. Skirt **110** has an interior annular reaction surface **112** which tapers inwardly from top to bottom. This surface **112** serves as a surface against which a plurality of pipe slip segments **200** can react as explained later. This surface is not used if other attachment means, such as the screw actuated lock pins **205**, shown in FIG. 7, are used.

Skirt **110** also has a plurality of longitudinal guide slots **120** machined vertically at locations equally spaced around the entire circumference of skirt **110**. These guide slots **120** guide the slip segments **200** in a vertical path as slip segments **200** engage or disengage the outer surface of drive pipe B.

Threaded through the wall of adaptor cylindrical member **100** at the top edge of reaction surface **112** are a plurality of set screws **130**, each of which is located above a guide slot **120**. Set screw **130** has on its outer end a head **134** outside cylindrical member **100** by means of which set screw **130** can be turned to thread substantially horizontally into or out of cylindrical member **100**. On the inner end of set screw **130** is force cone **132**, which is a conical surface shaped to apply force inwardly and downwardly on slip segment **200** as set screw **130** is threaded inwardly through cylindrical member **100**.

A plurality of slip segments **200** are located on reaction surface **112** of skirt **110**, evenly spaced around the entire circumference of skirt **110** aligned with the guide slots **120**. Slip segment **200** is substantially triangular in cross-section. Outwardly facing slip reaction surface **210** tapers inwardly from a point **215** on the outer surface of slip segment **200** to the lower end of segment **200**. Slip reaction surface **210** slides on skirt reaction surface **112**. Outwardly facing slip drive surface **220** tapers inwardly from the same point **215** to the upper end of segment **200**. Force cone **132** on set screw **130** slides on slip drive surface **220**. The third side of slip segment **200** is substantially vertical gripping surface **230** which has upwardly sloping slip teeth, which press against the outer surface of drive pipe B.

Threaded into reaction surface **210** of slip segment **200** is slip segment guide pin **240**. Guide pin **240** extends horizontally from slip segment **200** through guide slot **120** for the purpose of guiding slip segment **200** in a vertical path as slip segment **200** moves upwardly or downwardly on skirt reaction surface **112**.

Machined into the interior surface of adaptor cylindrical member **100** above set screws **130** is an annular seal groove **145** which can communicate to the outside of cylindrical member **100** through a plurality of seal ports **140** machined through the wall of cylindrical member **100**. Lying within seal groove **145** is elastomeric seal ring **300** which contacts the surface of drive pipe B around its entire circumference. Seal ring **300** can be a variety of seal types, but it is shown having upper and lower anti-extrusion members **310** and **320**. Seal ports **140** are used to pressurize seal groove **145** outside or behind seal ring **300**, forcing seal ring **300** into sealing contact with the outer surface of drive pipe B. Seal ports **140** can also be used to pressure test seal **300**.

Machined into the interior surface of cylindrical member **100** above seal groove **145** is downwardly facing annular stop shoulder **170** against which the upper end of drive pipe B abuts when drive pipe B is fully inserted into diverter adaptor A. For appropriate applications, casing hanger bowl **180** can be machined into the interior surface of cylindrical member **100** above the location of stop shoulder **170**. Shown in FIG. **4** is an alternate embodiment of the invention having no stop shoulder, but having instead stop collar **400** threaded into collar acme threads **190** which are machined into the interior surface of cylindrical member **100** above seal groove **145**. Stop collar **400** acts as a height-adjustable stop shoulder.

Penetrating the wall of cylindrical member **100** above stop shoulder **170**, or above stop collar threads **190** are a plurality of threaded outlets **150** which can be used as pressure ports or as connection points for other low pressure purposes.

The diverter adaptor is installed on the end of a drive pipe B as follows. After the drive pipe B is driven into the borehole, its upper edge is machined or filed sufficiently to remove any outwardly extending burrs or sharp edges. As shown in FIG. **1**, diverter adaptor A is then lowered over the exposed end of drive pipe B until the upper end of drive pipe B bottoms out on stop shoulder **170**. At this stage, seal ring **300** is still seated within seal groove **145**, not contacting drive pipe B. Also, pipe slip segments **200** are near the top of their travel and free to move upwardly or downwardly because set screws **130** are fully backed out so that force cone **132** retracts within the wall of cylindrical member **100**.

As seen in FIG. **2**, set screws **130** are then incrementally threaded into cylindrical member **100** to contact slip segments **200** and then force slip segments **200** downwardly. The same principle would be used if screw actuated lock pins **205** are used, as shown in FIG. **7**, instead of slip segments **200**. Threaded collars **206** are screwed into cylindrical member **100** to force lock pins **205** inwardly, forcing lock pin teeth **207** into drive pipe B. The incremental threading of set screws **130** is sequenced to insure that all set screws **130** are inserted at a relatively even rate, avoiding any lateral displacement or cocking of cylindrical member **100**. As set screws **130** force slip segments **200** downwardly by contact between force cones **132** and slip drive surfaces **220**, force cones **132** slide along slip drive surfaces **220**.

Downward movement of slip segment **200** is resisted by contact between slip reaction surface **210** and skirt reaction surface **112**. Since surfaces **210** and **112** are angled relative to the downward movement of slip segments **200**, skirt reaction surface **112** exerts a horizontal reaction force inwardly against slip reaction surface **210**. This causes slip segment **200** to move inwardly against the outer surface of drive pipe B as slip reaction surface **210** slides down skirt reaction surface **112**. This forces the upwardly canted teeth on gripping surface **230** to dig into the outer surface of drive pipe B. As slip segment **200** moves downwardly, it is constrained to a vertical path by the sliding of guide pin **240** in vertical guide slot **120**.

Next, as shown in FIG. **3** a self-sealing fluid is introduced into seal port **140** under sufficient pressure to unseat seal ring **300** and to move seal ring **300** into intimate contact with the outer surface of drive pipe B. In the seal design shown here, anti-extrusion members **310** and **320** prevent seal ring **300** from extruding into the annular space between cylindrical member **100** and drive pipe B.

After slip segments **200** have been set against drive pipe B as described above, and after seal ring **300** has been seated against drive pipe B as described above, the effectiveness of seal **300** can be tested. This can be accomplished in a variety of ways, depending upon the style of seal being used. Generally, testing will involve the application of a pressurized fluid inside drive pipe B against a plug, accompanied by measurement of leakage past the seal.

During testing of the seal or during pressure testing of equipment installed atop diverter adaptor A, diverter adaptor A can move slightly upwardly before slip segments **200** adequately grip drive pipe B to stop movement. This movement can be compensated for, in the alternate embodiment of the invention, as seen in FIGS. 4 and 5. In FIG. 4, drive pipe B is separated from stop collar 400 during pressure testing, by a slight upward movement of diverter adaptor A. If left in this condition, in some applications, some stability is lost, and slip segments 200 might eventually require tightening. To compensate for this upward movement, stop collar 400 is threaded down into tight contact with the upper end of drive pipe B as shown in FIG. 5. This tightening is accomplished prior to mounting any equipment on adaptor flange 160, by inserting a collar tightening tool through the top of diverter adaptor A.

A third feature of this invention, which can be incorporated if desired, is shown in FIG. 6. Instead of forcing pipe slip segments 200 against drive pipe B by tightening set screws 130, slip segments 200 can be driven inwardly by wedge ring 500, suspended beneath cylindrical member 100. Wedge ring 500 has an annular tapered drive surface 512 on its interior, against which slip reaction surface 210 lies. Wedge ring drive surface 512 tapers inwardly from top to bottom.

Wedge ring 500 is driven upwardly by tightening nuts 514 on studs 516 which extend from beneath through wedge ring 500 and into the lower end of cylindrical member 100. As nuts 514 are tightened, wedge ring 500 rises, driving slip segments 200 upwardly and inwardly until slip surface 230 contacts drive pipe B. Here again, a variety of seal types can be used, with one type being shown only for illustration purposes. In this embodiment, the tightening of wedge ring 500 can be utilized to inject a sealing compound behind the seal to drive it inwardly, or the seal itself can physically be driven inwardly by movement of the wedge ring, if desired. As a fourth feature, screw actuated lock pins 205 can be used, as shown in FIG. 7, in lieu of slip segments 200.

The description given here is illustrative only. Various modifications and variations are possible without departing from the spirit of this invention. It is intended that all such variations be encompassed in the attached claims.

I claim:

1. An adaptor for use at a wellhead on the upper end of a well pipe disposed in and extending above a wellbore, comprising:

a cylindrical member having an upper portion and a lower portion and an intermediate stop shoulder therebetween adapted to be positioned on the upper end of a well pipe;

a flange on the upper portion of said cylindrical member;

a plurality of wedge-shaped pipe attachment means attached to said cylindrical member on an interior surface of the lower portion of said cylindrical member;

means for engaging said attachment means and forcing said attachment means inwardly relative to said cylindrical member; and

a seal on said interior surface of said cylindrical member between said flange and said pipe attachment means for forming a seal with the well pipe.

2. The adaptor of claim 1, wherein said attachment means are slip segments and said means for engaging comprise a plurality of set screws threaded through said cylindrical member so as to contact said slip segments.

3. The adaptor of claim 1, wherein said attachment means are screw actuated lock pins and said means for engaging comprise threaded collars on said lock pins.

4. The adaptor of claim 1, wherein said attachment means are slip segments and said means for engaging comprises a wedge ring attached to said member by threaded fasteners so that when said fasteners are tightened, said wedge ring rises to urge said slip segments upwardly and inwardly.

5. The adaptor of claim 2, further comprising:

a first annular tapered face on said interior surface of said cylindrical member where said slip segments are attached to said cylindrical member, tapered inwardly from top to bottom of said first tapered face;

a second tapered face on an outer surface of each of said slip segments, tapered inwardly from top to bottom of said face, where said segment contacts said annular tapered surface of said cylindrical member so as to move said slip segment inwardly or outwardly as said slip segment is moved downwardly or upwardly.

6. The adaptor of claim 5, further comprising:

a plurality of longitudinal slots formed vertically in a wall of said cylindrical member where said slip segments contact said cylindrical member; and

a plurality of pins mounted on said second tapered faces of said slip segments and extending therefrom through said longitudinal slots for aligning said slip segments substantially with said slots as said slip segments move upwardly and downwardly.

7. The adaptor of claim 5, further comprising:

a third tapered face on said outer surface of each of said slip segments, tapered outwardly from top to bottom of said third tapered face; and

a conical surface on an inwardly disposed end of each of said set screws slidably engaging said third tapered face on each of said slip segments so as to force said slip segments downwardly as said set screw is threaded inwardly into said cylindrical member.

8. The adaptor of claim 1, wherein said seal includes:

two sealing elements, a first element disposed vertically above a second element;

a test port through a wall of said cylindrical member into a space between said sealing elements for measuring a test pressure of test fluid escaping past said sealing elements from inside said cylindrical member; and

a pressure port through said wall of said cylindrical member above said seal for applying pressure to a test fluid inside said member.

9. The adaptor of claim 1, further comprising means for applying sealing fluid under pressure to force said seal inwardly to seal against the well pipe inserted within said cylindrical member.

10. The adaptor of claim 1, further comprising a means for stopping inward motion of the well pipe when the well pipe is inserted longitudinally into said cylindrical member.

11. The adaptor of claim 10, wherein said stopping means comprises an annular shoulder on said interior surface of said cylindrical member, disposed above said seal.

12. The adaptor of claim 10, wherein said stopping means comprises:

annular stop threads on said interior surface of said cylindrical member, disposed above said seal; and an annular stop collar, having an inner diameter smaller than the inner diameter of said cylindrical member, threaded into said annular stop threads inside said cylindrical member.

13. An adaptor for use in at a wellhead on the upper end of a well pipe disposed in and extending above a wellbore, comprising:

a cylindrical member having an upper portion and a lower portion and an intermediate stop shoulder therebetween adapted to be positioned on the upper end of a well pipe;

a flange on the upper portion of said cylindrical member;

a plurality of pipe attachment means attached to said cylindrical member on an interior surface of the lower portion of said cylindrical member;

means for engaging said attachment means and forcing said attachment means inwardly relative to said cylindrical member, wherein said attachment means are slip segments and said means for engaging comprise a plurality of set screws threaded through said cylindrical member so as to contact said slip segments;

a seal on said interior surface of said cylindrical member between said flange and said pipe attachment means for forming a seal with the well pipe;

a first annular tapered face on said interior surface of said cylindrical member where said slip segments are attached to said cylindrical member, tapered inwardly from top to bottom of said first tapered face; and

a second tapered face on an outer surface of each of said slip segments, tapered inwardly from top to bottom of said face, where said segment contacts said annular tapered surface of said cylindrical member so as to move said slip segment inwardly or outwardly as said slip segment is moved downwardly or upwardly.

14. An adaptor for use at a wellhead on the upper end of a well pipe disposed in and extending above a wellbore, comprising:

a cylindrical member having an upper portion and a lower portion and an intermediate stop shoulder therebetween adapted to be positioned on the upper end of a well pipe;

a flange on the upper portion of said cylindrical member;

a plurality of pipe attachment means attached to said cylindrical member on an interior surface of the lower portion of said cylindrical member;

means for engaging said attachment means and forcing said attachment means inwardly relative to said cylindrical member, wherein said attachment means are slip segments and said means for engaging comprise a plurality of set screws threaded through said cylindrical member so as to contact said slip segments;

a seal on said interior surface of said cylindrical member between said flange and said pipe attachment means for forming a seal with the well pipe;

a first annular tapered face on said interior surface of said cylindrical member where said slip segments are attached to said cylindrical member, tapered inwardly from top to bottom of said first tapered face;

a second tapered face on an outer surface of each of said slip segments, tapered inwardly from top to bottom of said face, where said segment contacts said annular tapered surface of said cylindrical member so as to move said slip segment inwardly or outwardly as said slip segment is moved downwardly or upwardly;

a plurality of longitudinal slots formed vertically in a wall of said cylindrical member where said slip segments contact said cylindrical member; and

a plurality of pins mounted on said second tapered faces of said slip segments and extending therefrom through said longitudinal slots for aligning said slip segments substantially with said slots as said slip segments move upwardly and downwardly.

15. An adaptor for use at a wellhead on the upper end of a well pipe disposed in and extending above a wellbore, comprising:

a cylindrical member having an upper portion and a lower portion and an intermediate stop shoulder therebetween adapted to be positioned on the upper end of a well pipe;

a flange on the upper portion of said cylindrical member;

a plurality of means for attaching to the well pipe wherein said means for attaching are connected to said cylindrical member on an interior surface of the lower portion of said cylindrical member;

means for engaging and forcing said means for attaching inwardly relative to said cylindrical member;

a seal on said interior surface of said cylindrical member between said flange and said pipe attachment means for forming a seal with the well pipe; and

a means for stopping inward motion of the well pipe when the well pipe is inserted longitudinally into said cylindrical member.

16. The adaptor of claim 15, wherein said means for stopping comprises an annular shoulder on said interior surface of said cylindrical member, disposed above said seal.

17. The adaptor of claim 15, wherein said means for stopping comprises:

annular stop threads on said interior surface of said cylindrical member, disposed above said seal; and

an annular stop collar, having an inner diameter smaller than the inner diameter of said cylindrical member, threaded into said annular stop threads inside said cylindrical member.

18. A method for attaching selected wellhead equipment to the upper end of a well drive pipe, comprising the steps of:

placing an adaptor cylinder over an exposed end of a drive pipe so that the exposed end of the drive pipe extends past an annular seal inside said adaptor cylinder and abuts a stop means on the interior surface of said adaptor cylinder;

engaging an engaging means for force a plurality of pipe attachment means inside said adaptor cylinder inwardly against an outer surface of the drive pipe;

engaging a seal between said cylinder and the well drive pipe;

pressurizing the interior of said adaptor cylinder with a test fluid to test for leakage; and

threading an annular stop collar down against the end of the drive pipe to eliminate any slack resulting from upward movement of said attachment means relative to the drive pipe during said pressurizing of the interior of said adaptor cylinder.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,936,382

DATED : June 26, 1990

INVENTOR(S) : Ronald D. Thomas

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In claim 13, column 7, line 5, cancel "in".

In claim 18, column 8, line 55, cancel "for" and insert --to--.

Signed and Sealed this

Twenty-second Day of October, 1991

Attest:

HARRY F. MANBECK, JR.

Attesting Officer

Commissioner of Patents and Trademarks